THE ACCURACY OF VEGETATION CHARACTERISTICS EXTRACTED FROM INTERFEROMETRIC SAR DATA

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Interferometric synthetic aperture radar (INSAR) data from vegetated areas are sensitive to the geometric and scattering characteristics of the vegetation. For example, INSAR returns from tall, dry vegetation canopies, for which the penetration of the radar signal may be large, will be characterized by lower correlation coefficient amplitudes than for either short or very wet canopies, for which the penetration will be small. The correlation is reduced by the incoherent sum of correlation phasors arising from a range altitudes within the canopy. The correlation is also affected by speckle and thermal noise and the topography of the terrain. In this paper, we investigate 1) approaches to modeling the complex INSAR cross correlation of the electric fields from each end of the baseline, 2) estimation procedures for extracting vegetation parameters, and 3) measurement and modeling errors affecting the extmeted parameters. The INSAR cross correlation is currently modeled using a coherent-field approach to treat volume scattering. For a given incidence angle and observing frequency, the estimation algorithm considers the complex, normalized cross-correlation and the radar cross section to be the three observed quantities. These three observed quantities are characterized by the following four parameters: 1) the canopy altitude, 2) the canopy thickness, 3) the extinction coefficient (attenuation per unit length), and 4) a term dependent on the average scattering amplitude and density of backscatterers in the canopy. For a single incidence angle, single-frequency observation, the parameters outnumber the observations, We will therefore demonstrate these estimation strategies on real INSAR data, with some parameters constrained by ground truth, and on simulated multi incidence-angle INSAR data. Nonlinear parameter estimation strategies will be described for extracting the vegetation parameters from the data. The estimation strategies will be tested on INSAR data from Bonanza Creek Experimental Forest in Alaska, Mt. Adams in Washington, San Francisco, and Pasadena. In order to assess the errors in parameter estimates, we will test extracted parameters for internal consistency, compare parameters to ground truth, and present theoretical (analytic and simulated) results on the effects of speckle and thermal noise on the extracted parameters. The effect of mismodeling the scattering mechanisms on the extracted vegetation parameters will also be discussed, as well as plans for improvements to the modeling. The 4 parameter estimation approach described here will be compared to a single parameter, penetration depth estimation approach presented by Rodriguez, Michel, and Harding at this conference.